ARKANSAS

K-12 SCIENCE STANDARDS

EDUCATION FOR A NEW GENERATION

Science Alternate Assessment

Resource Guide

Grade Seven

July 2017

PREFACE

All students are expected to participate in state assessments. Students with disabilities who are served in their school districts under an Individualized Education Program (IEP) as required by the Individuals with Disabilities Education Act Amendments of 2004 (IDEA) and Every Student Succeeds Act (ESSA) of 2015, shall be assessed in science in one of two ways.

1. ACT Aspire Science Assessment with accommodations for grades 3-10, or
2. Students with significant disabilities, for whom the science portion of the ACT Aspire assessment is not appropriate, shall participate in an alternate science assessment.

This guide should assist school personnel who serve students with significant cognitive disabilities in conceptualizing, planning, and implementing the Arkansas K-12 Science Standards. The content standards are the same for all students in Arkansas. The difference for students with significant cognitive disabilities is the manner in which they are assessed.

The following document contains extensions of many of the Arkansas K-12 Science Standards offering teachers ideas to provide scientific experiences and expectations for students with significant cognitive disabilities. The Alternate Assessment will align with the Arkansas K-12 Science Standards.

Disciplinary Core Ideas
Physical Science (PS)
Life Science (LS)
Earth and Space Science (ESS)
Engineering, Technology, and Applications of Science (ETS)

In June of 2016, the Arkansas Department of Education convened a committee of educators including science teachers, special education teachers, and administrators to collaborate and develop the following resource guide. The goal for this guide is to target and extend standards for the development of assessment tasks. It is not the purpose of this document to limit in any way what standards are being taught nor to provide a curriculum for schools. The Arkansas K-12 Science Standards were developed with an “All Standards, All Students” vision which the committee embraced.

This publication includes selected standards from the Arkansas K-12 Science Standards. Further information about the Arkansas K-12 Science Standards can be found here. This resource guide is organized to present the standard with supporting foundations, and suggests using the instructional strategy of *gathering, reasoning, and communicating* for instruction with varying levels of expected performance. The committee encourages the use of this document as one resource to assist teachers of students with significant cognitive disabilities. It should not be used as a checklist, a menu of alternate assessment items, or as IEP goals or objectives. The resources listed in this document are intended to give teachers some ideas of ways to access materials for teaching science to students with sever cognitive disabilities. This is not an exhaustive list and Web sources may change over time.

Committee

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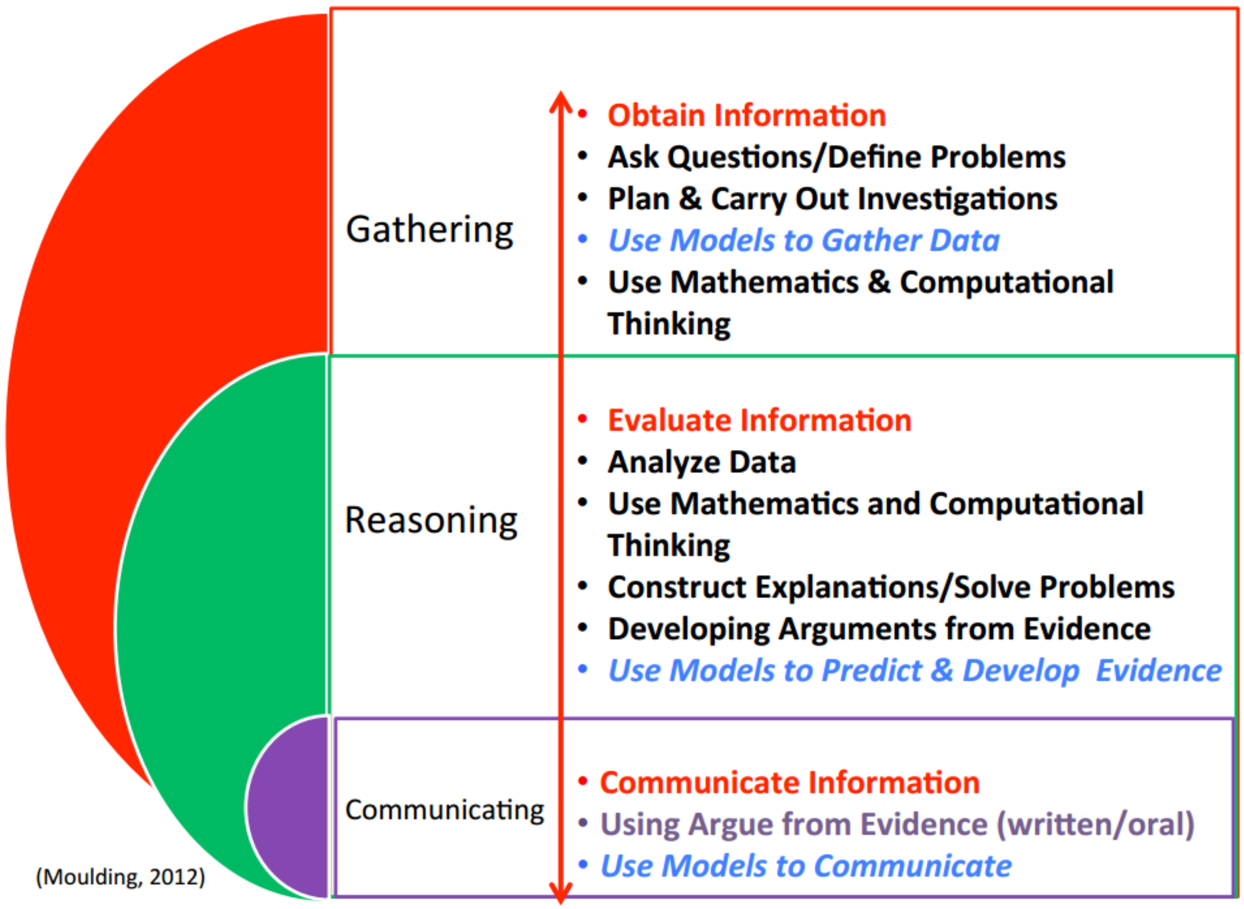
Notes:

1. Student Performance Expectations (PEs) may be taught in any sequence or grouping within a grade level.
2. An asterisk (*) indicates an engineering connection to a practice, core idea, or crosscutting concept.
3. The Clarification Statements are examples and additional guidance for the instructor. **AR** indicates Arkansas-specific Clarification Statements.
4. The Assessment Boundaries delineate content that may be taught but not assessed in large-scale assessments. **AR** indicates Arkansas-specific Assessment Boundaries.

Organization of Instruction



(Moulding, 2012)

Disciplinary Core Ideas				
Grade 3	Physical Science	Life Science		Earth and Space Science
	Forces and Interactions	Interdependent Relationships in Ecosystems	Inheritance and Variation	Weather and Climate
	3-PS2-1 3-PS2-2	3-LS2-1 3-LS4-3 3-LS4-4	3-LS1-1 3-LS3-1 3-LS3-2	3-ESS2-1 3-ESS2-2 3-ESS3-1
Engineering, Technology, and Applications of Science, 3-ETS1-1				

Grade 4	Physical Science	Life Science	Earth and Space Science	
	Energy	Structure, Function and Information Processing	Energy	Earth’s Systems
	4-PS3-1 4-PS3-2 4-PS3-3	4-LS1-1 4-LS1-2	4-ESS3-1	4-ESS2-1 4-ESS2-2 4-ESS3-2
Engineering, Technology, and Applications of Science, 4-ETS1-1				

Grade 5	Physical Science			Life Science	Earth and Space Science	
	Space Systems	Structure and Properties of Matter	Matter and Energy in Organisms & Ecosystems	Matter and Energy in Organisms and Ecosystems	Earth’s Systems	Space Systems
	5-PS2-1	5-PS1-2 5-PS1-3 5-PS1-4	5-PS3-1	5-LS2-1	5-ESS2-1 5-ESS3-1	5-ESS1-2
Engineering, Technology, and Applications of Science, 5-ETS1-1						

Grade 6	Physical Science	Life Science		Earth and Space Science		
	Energy	Structure, Function and Information Processing	Growth, Development and Reproduction of Organisms	Earth’s Systems	Human Impacts	Weather and Climate
	6-PS3-3	6-LS1-1 6-LS1-2 6-LS1-3	6-LS1-4 6-LS3-2	6-ESS2-4	6-ESS3-3 6-ESS3-4	6-ESS2-5
Engineering, Technology, and Applications of Science, 6-ETS1-1, 6-ETS1-4						

Grade 7	Physical Science		Life Science		Earth and Space Science		
	Structures and Properties of Matter	Chemical Reactions	Interdependent Relationships in Ecosystems	Matter and Energy in Organisms and Ecosystems	Earth’s Systems	History of Earth	Human Impacts
	7-PS1-1 7-PS1-3 7-PS1-4	7-PS1-2	7-LS2-2 7-LS2-5	7-LS1-6 7-LS2-1 7-LS2-4	7-ESS2-1	7-ESS2-2 7-ESS2-3	7-ESS3-2
Engineering, Technology, and Applications of Science, 7-ETS1-1, 7-ETS1-2							

Grade 8	Physical Science		Life Science	Earth and Space Science	
	Waves and Radiation	Forces and Interactions	Natural Selection and Application	Space Systems	History of Earth
	8-PS4-1 8-PS4-2	8-PS2-1 8-PS2-2 8-PS2-3	8-LS4-1 8-LS4-2 8-LS4-3 8-LS4-4	8-ESS1-1 8-ESS1-3	8-ESS1-4
Engineering, Technology, and Applications of Science, 8-ETS1-2					

GRADE SEVEN

Structure and Properties of Matter

Students who demonstrate understanding can:

7-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.

[Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3-D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

FOUNDATIONS:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to predict and/or describe phenomena. (7-PS1-1)	**PS1.A: Structure and Properties of Matter** ▪ Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (7-PS1-1) ▪ Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (7-PS1-1)	**Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (7-PS1-1)

Simple models: hydrogen, water, salt, sugar, carbon dioxide			
	LESS COMPLEX	→	MORE COMPLEX
GATHERING	Use a model *(teacher guided)* to describe the atomic composition of one simple molecules.	Use models *(teacher/student guided)* to describe the atomic composition of simple molecules that have different observable properties.	Use models *(student guided)* to describe extended structures of molecules.
REASONING	Develop a model from evidence of a simple molecule to identify atomic composition.	Develop models from evidence of simple molecules showing different observable properties.	Develop a models from evidence to describe extended structures of molecules.
COMMUNICATING	Use a model *(oral, written, or augmented*) to label the parts of a molecule.	Use models *(oral, written, or augmented*) to communicate the different observable properties of a molecule.	Use models *(oral, written, or augmented)* of molecules to communicate the extended structures of molecules.

Investigations could include ball and stick model, salt crystal structures, and counting atoms.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Build a Molecule

Structure and Properties of Matter		
Students who demonstrate understanding can: **7-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form a synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (7-PS1-3)	**PS1.A: Structure and Properties of Matter** ▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (7-PS1-3)	**Structure and Function** ▪ Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (7-PS1-3)

Phenomenon: Carbon fuels to make plastics, trees to disposable diapers, witch hazel to aspirin			
	LESS COMPLEX	→	MORE COMPLEX
GATHERING	Obtain information *(teacher provided)* using grade-appropriate text and/or media about how synthetic materials come from natural resources.	Obtain and summarize information *(teacher/student guided)* from grade-appropriate text and/or media about how synthetic materials come from natural resources.	Obtain and summarize information *(student guided)* from grade-appropriate text and/or media about how synthetic materials come from natural resources.
REASONING	Analyze information gathered to identify items as a natural resource or synthetic material.	Analyze images of stages in the production of synthetic material from natural resources.	Analyze information in written texts, charts, tables, and diagrams to support the process of natural resources becoming synthetic materials and how it impacts society.
COMMUNICATING	Communicate *(oral, written or augmented)* the difference between synthetic materials and natural resources.	Communicate *(oral, written or augmented)* information or design ideas and/or solutions using models, drawings, writings, or numbers that provide details about how natural resources are used to make synthetic materials.	Communicate scientific and/or technical information *(oral, written or augmented)* individually, including various forms of media and may include tables, diagrams, and charts about how natural resources are used to make synthetic materials and how it impacts society.

Investigations could include researching plastics, medicines, petroleum, and other synthetic materials, sequencing the process of forming synthetic materials from natural resources.

Website: www.MiddleSchoolChemestry.com

*Natural Resources and Synthetic Materials

Structure and Properties of Matter		
Students who demonstrate understanding can: **7-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings or diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop a model to predict and/or describe phenomena. (7-PS1-4)	**PS1.A: Structure and Properties of Matter** ▪ Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (7-PS1-4) ▪ In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (7-PS1-4) ▪ The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (7-PS1-4)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-PS1-4)

Phenomenon: Matter changes states when heat is added or removed.			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Use a simple model *(teacher guided)* to describe particle motion when heat is removed from a system.	Use a simple model *(teacher/student guided)* to describe particle motion when a system changes from a solid to a liquid to a gas.	Use a simple model *(student guided)* to describe particle motion when a system changes from a gas to a liquid to a solid.
REASONING	Create a model to identify differences in particle motion when heat is removed from a system.	Create a model to identify differences when heat is added to a system.	Create a model to identify differences when heat is removed from a system.
COMMUNICATING	Use the model to communicate differences in particle motion when heat is removed from a system.	Use the model to communicate differences in particle motion when heat is added to a system.	Use the model to communicate differences in particle motion when heat is removed from a system.

Investigations could include changes in the states of water.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Molecules in Motion
*States of Matter Basics
*Changes of State
*Changing State - Evaporation

Chemical Reactions		
Students who demonstrate understanding can: **7-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [**AR** Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrochloric acid.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to determine similarities and differences in findings. (7-PS1-2) **---** **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (7-PS1-2)	**PS1.A: Structure and Properties of Matter** ▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (7-PS1-2) **PS1.B: Chemical Reactions** ▪ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (7-PS1-2)	**Patterns** ▪ Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (7-PS1-2)

Phenomenon: chemical and physical changes.			
	LESS COMPLEX	→	MORE COMPLEX
GATHERING	Conduct an investigation *(teacher guided)* to identify a physical and chemical reaction.	Conduct an investigation *(teacher/student guided)* to identify physical and chemical reactions.	Conduct an investigation *(student guided)* to identify physical and chemical reactions.
REASONING	Analyze data from investigation to determine the properties of a physical and chemical reaction.	Analyze data from investigation to determine the properties of physical and chemical reactions.	Analyze data from investigation to determine the properties of physical and chemical reactions.
COMMUNICATING	Communicate *(oral, written, or augmented)* the properties of physical and chemical reactions.	Communicate *(oral, written, or augmented)* the properties of physical and chemical reactions.	Communicate *(oral, written, or augmented)* the properties of physical and chemical reactions.

Investigations could include changes in the phase of water adding and removing heat and a chemical reaction is how hydrogen peroxide forms water, pipes rusting, burning or melting a sugar cube.

<u>Chemical Reaction Demonstrations</u>, Mr. Kish's Science Channel, YouTube.com

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Energy Changes in Chemical Reactions
*Baggie Chemistry
*Can you Copperplate
*Design and Build a Bio-suit
*Chemical Reactions Un-Notes

Interdependent Relationships in Ecosystems		
Students who demonstrate understanding can: **7-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (7-LS2-2)	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (7-LS2-2)	**Patterns** ▪ Patterns can be used to identify cause and effect relationships. (7-LS2-2)

Phenomenon: Living and non-living things existing together in an ecosystem, and predator and prey relationships sometimes display patterns.			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Obtain information *(teacher provided)* about the patterns of interactions among organisms in mutually beneficial relationships in ecosystems.	Obtain information *(teacher/student provided)* about the patterns of interactions among organisms in predatory and mutually beneficial relationships in ecosystems.	Obtain information *(student provided)* about the patterns of interactions among organisms in competitive, predatory, and mutually beneficial relationships in ecosystems.
REASONING	Evaluate information to identify patterns of interactions among organisms and abiotic factors in an ecosystem.	Evaluate information to identify patterns of interactions among organisms and abiotic factors in an ecosystem.	Evaluate information to identify patterns of interactions among organisms and abiotic factors in an ecosystem.
COMMUNICATING	Communicate information about the mutualistic patterns of interactions in ecosystems.	Communicate information about the predatory and mutualistic patterns of interactions in ecosystems.	Communicate information about the competitive, predatory and mutualistic patterns of interactions in ecosystems.

Investigations could include sucker fish on sharks, or clown fish and anemone for mutually beneficial relationships, eagles and fish, fox and rabbits for predatory relationships, and woodpeckers and squirrels for nesting rights in trees as competitive relationships, and flora of the deciduous forest in competition for light.

Website: http://ngss.nsta.org/Classroom-Resources.asp

*Interactive Independence
*Florida's Everglades: The River of Grass
*Do Insects Prefer Local or Foreign Foods?
*Architects of Seamount Ecosystems
*The Jubilee Phenomenon

<table>
<tr><td colspan="3">Interdependent Relationships in Ecosystems</td></tr>
<tr><td colspan="3">Students who demonstrate understanding can:
7-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, or prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]</td></tr>
<tr><td colspan="3">FOUNDATIONS:</td></tr>
<tr><td>Science and Engineering Practices</td><td>Disciplinary Core Ideas</td><td>Crosscutting Concepts</td></tr>
<tr><td>Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
▪ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (7-LS2-5)</td><td>LS2.C: Ecosystem Dynamics, Functioning, and Resilience
▪ Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (7-LS2-5)
LS4.D: Biodiversity and Humans
▪ Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (7-LS2-5)
ETS1.B: Developing Possible Solutions
▪ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (7-LS2-5)</td><td>Stability and Change
▪ Small changes in one part of a system might cause large changes in another part. (7-LS2-5)

Connections to Engineering, Technology, and Applications of Science
Influence of Science, Engineering, and Technology on Society and the Natural World
▪ The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (7-LS2-5)
Connections to Nature of Science
Science Addresses Questions About the Natural and Material World
Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (7-LS2-5)</td></tr>
</table>

Design solutions could include: erosion prevention techniques, water filters, and composting.			
	LESS COMPLEX	→	MORE COMPLEX
GATHERING	Obtain information *(teacher guided)* about solutions to for maintaining biodiversity in an ecosystem.	Obtain information *(teacher/student guided)* about solutions to for maintaining biodiversity and an ecosystem service in an ecosystem.	Obtain information *(student guided)* about solutions to for maintaining biodiversity and ecosystem services in ecosystems.
REASONING	Evaluate information to identify a design solution to for a problem in an ecosystem.	Evaluate information about competing design solutions to select a solution for a problem in an ecosystem.	Evaluate information about competing design solutions and constraints to formulate ideas about solutions to a problem in an ecosystem.
COMMUNICATING	Make a claim *(oral, written or augmented)* about the effectiveness of a solution for an ecosystem service.	Make a claim *(oral, written or augmented)* and support with evidence about the effectiveness of a solution for an ecosystem service.	Make a claim *(oral, written or augmented)* and support with evidence using both solutions and constraints about the effectiveness of an ecosystem service.

Investigations could include models, water filters, composting devices, and erosion experiments (stream table), reintroduction of elk in the Ozarks, levees along rivers.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Where's the Beach? – Investigation Ways to Protect Shorelines from Erosion
*Dueling Mandates
*Flow of Matter and Energy in Ecosystems
*SciGirls: Turtle Power (Season1, Episode 1)

Matter and Energy in Organisms and Ecosystems		
Students who demonstrate understanding can: **7-LS1-6** **Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-LS1-6) --- **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science knowledge is based upon logical connections between evidence and explanations. (7-LS1-6)	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (7-LS1-6) **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (7-LS1-6)	**Energy and Matter** ▪ Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (7-LS1-6)

Phenomenon: The source of all energy is the sun			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Use models *(teacher provided)* to gather information about the importance of photosynthesis to life on earth.	Use models *(teacher/student provided)* to gather evidence for the role of photosynthesis in the cycling of energy.	Use models *(student provided)* to gather evidence about the cycling of matter into and out of systems.
REASONING	Use information from models to develop evidence about the importance of photosynthesis to life on earth.	Use information from models to develop evidence about the role of photosynthesis in the cycling of energy.	Use information to construct an explanation for the role that photosynthesis has in the cycling of matter in and out of organisms.
COMMUNICATING	Communicate information *(oral, written, augmented)* from models about the importance of photosynthesis to life on earth.	Communicate information *(oral, written, augmented)* from models about the importance of the role of photosynthesis in the cycling of energy.	Communicate information *(oral, written, augmented)* from models about the importance of the role of photosynthesis in the cycling of matter in and out of organisms.

Investigations could include diagrams of the cycling of matter and energy.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Investigating Photosynthesis
*Detecting Photosynthesis
*Plant Biomass
*Carbon TIME Plants Unit – Lesson 4: Explaining How Plants Make Food, Move, and Function
*Exploring Energy Transformation in Plants

Matter and Energy in Organisms and Ecosystems		
Students who demonstrate understanding can: **7-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to provide evidence for phenomena. (7-LS2-1)	**LS2.A: Interdependent Relationships in Ecosystems** ▪ Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (7-LS2-1) ▪ In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (7-LS2-1) ▪ Growth of organisms and population increases are limited by access to resources. (7-LS2-1)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-LS2-1)

Phenomenon: Growth or decline of organisms/populations based on resources available in an ecosystem			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Plan and carry out investigations *(teacher guided group collaboration)* simulating population changes during periods of plentiful resources, and times of resource distress.	Plan and carry out investigations *(teacher/student guided group collaboration)* simulating population changes during periods of plentiful resources, and times of resource distress.	Plan and carry out investigations *(student guided group collaboration)* simulating population changes during periods of plentiful resources, and times of resource distress.
REASONING	Analyze data to describe patterns and/or cause and effect relationships of population changes in ecosystems.	Analyze data to describe patterns and cause and effect relationships of population changes in ecosystems.	Analyze and interpret data to predict populations changes based on resource availability as causal factors.
COMMUNICATING	Communicate *(oral, written, or augmented)* the effects of resource availability on organisms in ecosystems.	Communicate *(oral, written, or augmented)* the effects of resource availability on organisms and patterns of population changes in ecosystems.	Communicate *(oral, written, or augmented)* the effects of resource availability on organisms and patterns of population changes in ecosystems and predictions based on evidence.

Investigations could include pHET simulations, WET and WILD activities (Oh Deer), video, online games, studies by ecologist Dan Janzen, found on website: http://www.pbs.org/wgbh/nova/nature/plant-vs-predator.html
Website: https://betterlesson.com/lesson/639457/exploring-resource-availability-and-population-size
Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Habitable Planet Population Simulator
*Climate Change and Michigan Forests
*Chesapeake Bay Food Web

Matter and Energy in Organisms and Ecosystems		
Students who demonstrate understanding can: **7-LS2-4** **Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ▪ Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (7-LS2-4) --- **Scientific Knowledge is Based on Empirical Evidence** ▪ Science disciplines share common rules of obtaining and evaluating empirical evidence. (7-LS2-4)	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ▪ Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (7-LS2-4)	**Stability and Change** ▪ Small changes in one part of a system might cause large changes in another part. (7-LS2-4)

Phenomenon: Physical or biological components of an ecosystem can affect change in populations.			
	LESS COMPLEX	→	MORE COMPLEX
GATHERING	Plan and carry out investigations *(teacher guided group collaboration)* simulating changes in ecosystems that affect populations.	Plan and carry out investigations *(teacher/student guided group collaboration)* simulating changes in ecosystems that affect populations.	Plan and carry out investigations *(student guided group collaboration)* simulating changes in ecosystems that affect populations.
REASONING	Construct an explanation to determine that changes to physical or biological components of an ecosystem affect population growth or decline.	Construct an explanation to determine that changes to physical and biological components of an ecosystem affect population growth and decline.	Construct an explanation to determine that changes to physical and biological components of an ecosystem affect population growth and decline.
COMMUNICATING	Make a claim *(oral, written, or augmented)* about the impact of physical or biological components on populations.	Make a claim *(oral, written, or augmented)* about the impact of physical and biological components on populations.	Make a claim *(oral, written, or augmented)*, supported with empirical evidence, about the impact of physical and biological components on populations.

Investigations could include pHET simulations, Project WET and WILD activities, Arkansas Game and Fish Commission.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

- *Exploring the "Systems" in Ecosystems
- *Ocean Bully
- *Lab 11. Food Webs and Ecosystems: Which Member of an Ecosystem Would Affect the Food Web the Most if Removed?
- *No More Plants
- *HHMI Coral Bleaching

Earth's Systems		
Students who demonstrate understanding can: **7-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** [**AR** Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Arkansas specific examples of geologic materials include Karst, bauxite, and diamonds.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop and use a model to describe phenomena. (7-ESS2-1)	**ESS2.A: Earth's Materials and Systems** ▪ All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (7-ESS2-1)	**Stability and Change** ▪ Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (7-ESS2-1)

Phenomenon: Metamorphic, sedimentary, and igneous rock formation			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Use models *(teacher guided group collaboration)* to gather data about the role of sedimentary rock in the rock cycle.	Use models *(teacher/student guided group collaboration)* to gather data about the role of sedimentary and igneous rock in the rock cycle.	Use models *(student guided group collaboration)* to gather data about the role of sedimentary, igneous and metamorphic rock in the rock cycle.
REASONING	Create a model to show sedimentary rock and its role the rock cycle.	Create a model to show sedimentary and igneous rock and their role the rock cycle.	Create a model to show sedimentary, igneous and metamorphic rock and their role the rock cycle.
COMMUNICATING	Use models to communicate *(oral, written, or augmented)* the flow of energy through the rock cycle.	Use models to communicate (orally, written, or augmented) the flow of energy through the rock cycle.	Use models to communicate (orally, written, or augmented) evidence that the flow of energy affects the rock cycle.

Investigations could include rock with crayon shavings, rock/mineral identification kits, online simulations, and dough, clay or sand activities.

Website: www.learner.org/interactives/rockcycle/

*Annenberg Learner – Interactive Rock Cycle

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Rock Cycle Journal

*The Rain Man

*Crayon Rock Cycle

*Interactives: Rock Cycle

History of Earth		
Students who demonstrate understanding can: **7-ESS2-2** **Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-ESS2-2)	**ESS2.A: Earth's Materials and Systems** ▪ The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (7-ESS2-2) **ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (7-ESS2-2)	**Scale Proportion and Quantity** ▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (7-ESS2-2)

Phenomenon: Geologic features change over time.			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Obtain information *(teacher provided)* from observations about how landforms form from erosion.	Obtain information based on evidence *(teacher/student provided)* about how geoscience processes, (*erosion, plate tectonics, and/or meteor impacts)* have changed Earth's surface.	Obtain information based on multiple forms of evidence *(student provided)* about how geoscience processes, (*erosion, plate tectonics, and/or meteor impacts)* have changed Earth's surface.
REASONING	Use models to show patterns of landforms that were created geologically fast or slow.	Use models to show patterns of landforms that were created geologically fast or slow.	Use models to show patterns of landforms that were created geologically fast or slow.
COMMUNICATING	Communicate *(orally, written, or augmented*) using models about how the water erosion changed Earth's surface over time.	Communicate (orally, written or augmented) using models about how geologic catastrophic events (earthquake and volcanic eruption) changed Earth's surfaces over time.	Communicate *(orally, written or augmented)* using models about multiple geologic features (mountain, volcano, canyon) and the processes that shaped Earth's surfaces over time.

Investigations could include simulations, areas of erosion, topographic maps, diagrams, models, pictures, videos, and pictorial timelines.

Website: www.USGS.gov
Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Unit Plan: Change and Earth's History – Clues to Fast Environments
*Dig This! Erosion Investigation
*Hot Spot Activity
*Asteroid Impacts: The Debatable K-T Extinction
*Investigating Erosion
*Plate Tectonics

<table>
<tr><td colspan="3">History of Earth</td></tr>
<tr><td colspan="3">Students who demonstrate understanding can:
7-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, or trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]</td></tr>
<tr><td colspan="3">FOUNDATIONS:</td></tr>
<tr><td>Science and Engineering Practices</td><td>Disciplinary Core Ideas</td><td>Crosscutting Concepts</td></tr>
<tr><td>Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
▪ Analyze and interpret data to provide evidence for phenomena. (7-ESS2-3)

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence
▪ Science findings are frequently revised and/or reinterpreted based on new evidence. (7-ESS2-3)</td><td>ESS1.C: The History of Planet Earth
▪ Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (7-ESS2-3)
ESS2.B: Plate Tectonics and Large-Scale System Interactions
▪ Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth’s plates have moved great distances, collided, and spread apart. (7-ESS2-3)</td><td>Patterns
▪ Patterns in rates of change and other numerical relationships can provide information about natural systems. (7-ESS2-3)</td></tr>
</table>

Phenomenon: Pangaea, similar fossils can be found at different locations across the globe.			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Obtain information *(teacher provided)* about evidence of past plate motion. *(e.g., similar fossils on different continents)*	Obtain information *(teacher/student provided)* about evidence of past plate motion. *(e.g., fossils, landform continuations)*	Obtain information *(student provided)* about evidence of past plate motion. *(e.g., fossils, landforms, continental shapes, and seafloor structures, Pangaea)*
REASONING	Analyze data to determine patterns of past plate movement based on evidence of fossils.	Analyze and interpret data to determine past plate movement based on fossils and landforms.	Analyze and interpret data to determine past plate movement based on fossils, landforms, continental shapes, and seafloor structures.
COMMUNICATING	Use models *(oral, written or augmented)* of fossil distribution patterns to show past plate movement.	Use models *(oral, written or augmented)* to contrast information about the differences in data of past plate movement.	Use models *(oral, written or augmented)* to compare and contrast about the differences in data of past plate movement.

Investigations could include NSTA Plate Tectonic Puzzle, or USGS for topographical maps.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

- *Interactives – Dynamic Earth
- *Virtual Lab – Fossil Dating
- *Continental Drift Activity
- *Modeling Sea Level: Lateral and Vertical Facies Changes
- *Sea Floor Spreading Made Easy
- *Nano Fossils Reveal Seafloor Spreading Truth
- *Activity: A Plate Tectonic Puzzle

Human Impacts		
Students who demonstrate understanding can: **7-ESS3-2** **Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruption surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornados, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local, such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ▪ Analyze and interpret data to determine similarities and differences in findings. (7-ESS3-2)	**ESS3.B: Natural Hazards** ▪ Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (7-ESS3-2)	**Patterns** ▪ Graphs, charts, and images can be used to identify patterns in data. (7-ESS3-2) --- **Connections to Engineering, Technology, and Applications of Science** **Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (7-ESS3-2)

Phenomenon: Earthquakes, tsunamis, volcanic eruptions, severe weather, natural hazards			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Ask *(teacher guided)* questions about the occurrence of catastrophic events to determine which events *(severe weather)* are predictable.	Ask *(teacher/student guided)* questions about the occurrence of catastrophic events to determine which events *(variety of weather hazards)* are predictable and non-predictable.	Ask *(student guided)* questions about the occurrence of catastrophic events to determine which events *(tsunami, tornados, flooding, mud slides, volcanic eruptions)* are predictable and which are non-predictable.
REASONING	Construct explanations following discussion about predictable weather events.	Construct explanations following discussion using a variety of media about predictable and non-predictable events.	Construct explanations following discussion using a variety of media about predictable and non-predictable events.
COMMUNICATING	Communicate *(oral, written or augmented)* data of natural weather related hazards.	Communicate *(oral, written or augmented)* data of predictable and non-predictable events.	Communicate *(oral, written or augmented)* data using models of predictable and non-predictable events.

Investigations could include the use of informational text about Arkansas and Oklahoma natural disasters including tornados, floods, storms, earthquakes.

Website: http://ngss.nsta.org/Classroom-Resources.aspx

*Enrichment Activity 4: Storm Forecasting
*Hurricanes
*Hurricane Sandy, Her Brothers and Sisters, How to Mitigate Hurricane Damage

Engineering, Technology, and Applications of Science		
Students who demonstrate understanding can: **7-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** [**AR** Clarification Statement: Examples could include designing technologies (e.g., levees, dams, storm shelters) and determining their ability to mitigate the effects of future weather events.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ▪ Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (7-ETS1-1)	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (7-ETS1-1)	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (7-ETS1-1) The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (7-ETS1-1)

Problems: Protecting humans from natural hazards and severe weather events			
	LESS COMPLEX		MORE COMPLEX
GATHERING	Define problems *(teacher guided)* of the potential impacts on people during severe weather events.	Define problems *(teacher/student guided)* of the potential impacts on people during severe weather events.	Define problems *(student guided)* of the potential impacts on people during severe weather events.
REASONING	Solve a problem using one criterion and/or constraint to address the impact on humans.	Solve a problem using criteria and/or constraints to address the impact on humans and landforms.	Solve a problem using criteria and/or constraints to address the impact on ecosystems.
COMMUNICATING	Use media to communicate *(oral, written, or augmented)* information about the effectiveness of the solution for humans.	Use media to communicate *(oral, written, or augmented)* information about the effectiveness of the solution on humans and landforms.	Use media to communicate *(oral, written, or augmented)* information about the effectiveness of the solution on the ecosystem

Investigation should include the engineering design cycle. https://linkengineering.org

Engineering, Technology, and Applications of Science		
Students who demonstrate understanding can: **7-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** [**AR** Clarification Statement: Examples could include evaluating human technologies (e.g., levees, dams, storm shelters) and determining their ability to mitigate the effects of future weather events.]		
FOUNDATIONS:		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (7-ETS1-2)	**ETS1.B: Developing Possible Solutions** ▪ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (7-ETS1-2)	

Solutions: Competing design solutions for levees, dams, shelters			
	LESS COMPLEX	→	MORE COMPLEX
GATHERING	Plan and carry out investigations *(teacher led)* to compare two designs of a possible solutions that would impact human safety.	Plan and carry out investigations *(teacher/student led)* to compare two designs of a possible solution that would impact human safety.	Plan and carry out investigations *(student led)* to compare two designs of possible solutions that would impact human safety.
REASONING	Evaluate the criterion and/or constraint of the solution that impacts human safety.	Evaluate the criterion and/or constraint of the solution that impacts human safety.	Evaluate the criterion and/or constraint of the solution that impacts human safety.
COMMUNICATING	Argue from evidence *(oral, written, or augmented)* that the solution is superior to the other.	Argue from evidence *(oral, written, or augmented)* that the solutions are superior to others.	Argue from evidence *(oral, written, or augmented)* that the solutions are superior to the others.

Investigations could include comparing building materials or designs used in the past to what is used now. Investigations should include the engineering design cycle. https://linkengineering.org